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(54) **Article-handling apparatus for transferring articles between conveyors**

(57) An article-handing apparatus for a lehr loader or stacker transfers a series of articles (B) advancing in a first coordinate direction on a cross conveyor (14) across a dead plate (16) on to a lehr conveyor (12) in groups which form rows or ranks of articles for movement through an annealing lehr. The apparatus includes a pusher bar (22) which engages a group of articles on the cross conveyor and moves them across the dead plate between the two conveyors along a predefined path that imposes minimium changes in speed and direction to prevent damage or distortion to the articles. The path followed by each article is defined by one of a plurality of predetermined displacement programs stored in the memory of a programmable controller. The pusher bar (22) is supported on a system of carriages (30,32) that can be moved independently in the first coordinate direction and perpendicular thereto in the direction of advance of the lehr conveyor (12) and preferable also in a further perpendicular direction to raise or lower the bar.
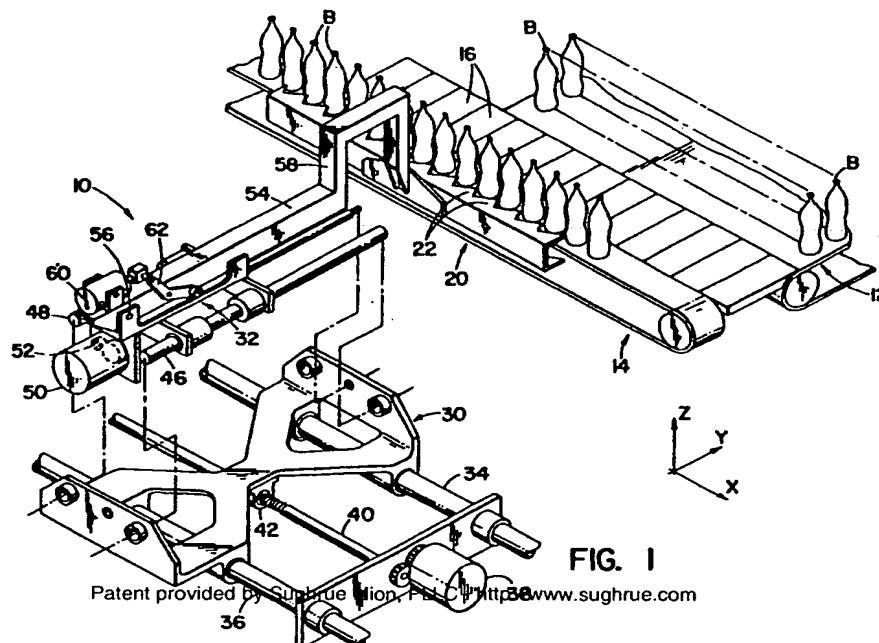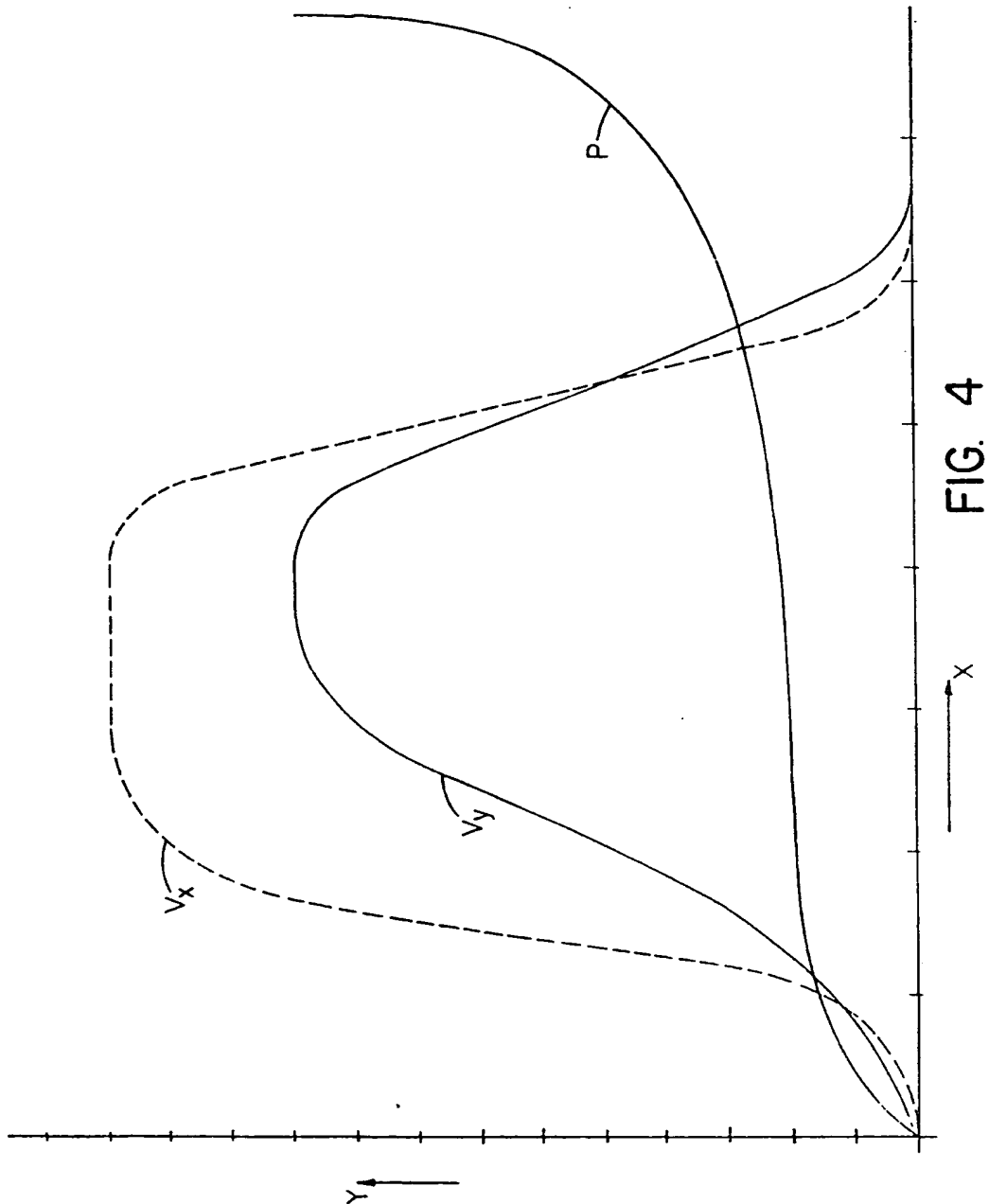
FIG. I

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FIG. 1

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FIG. 2

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FIG. 3

FIG. 4
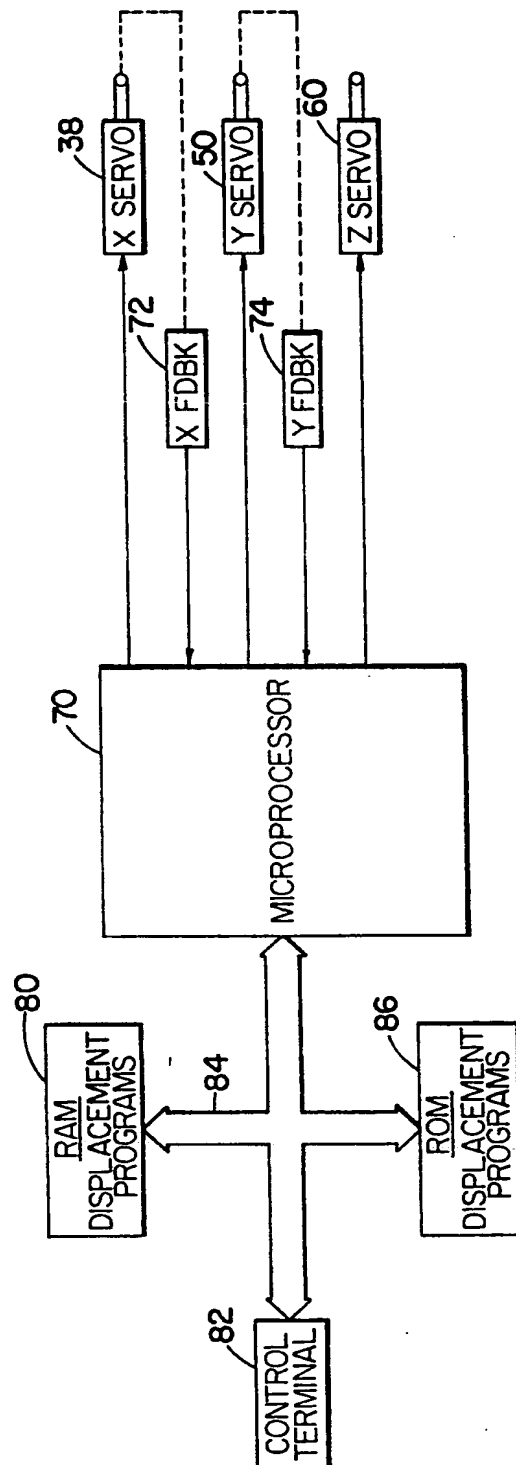
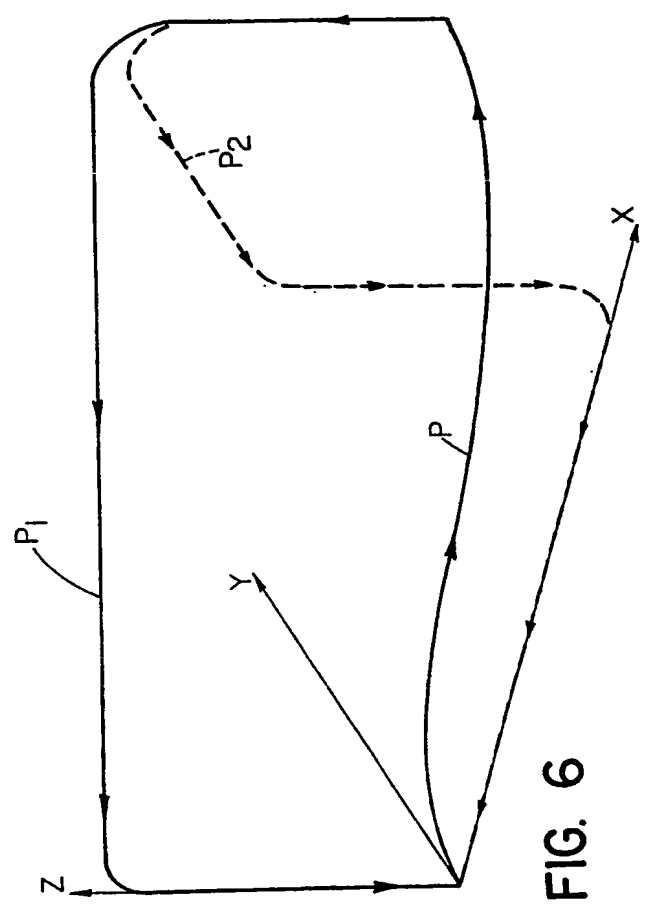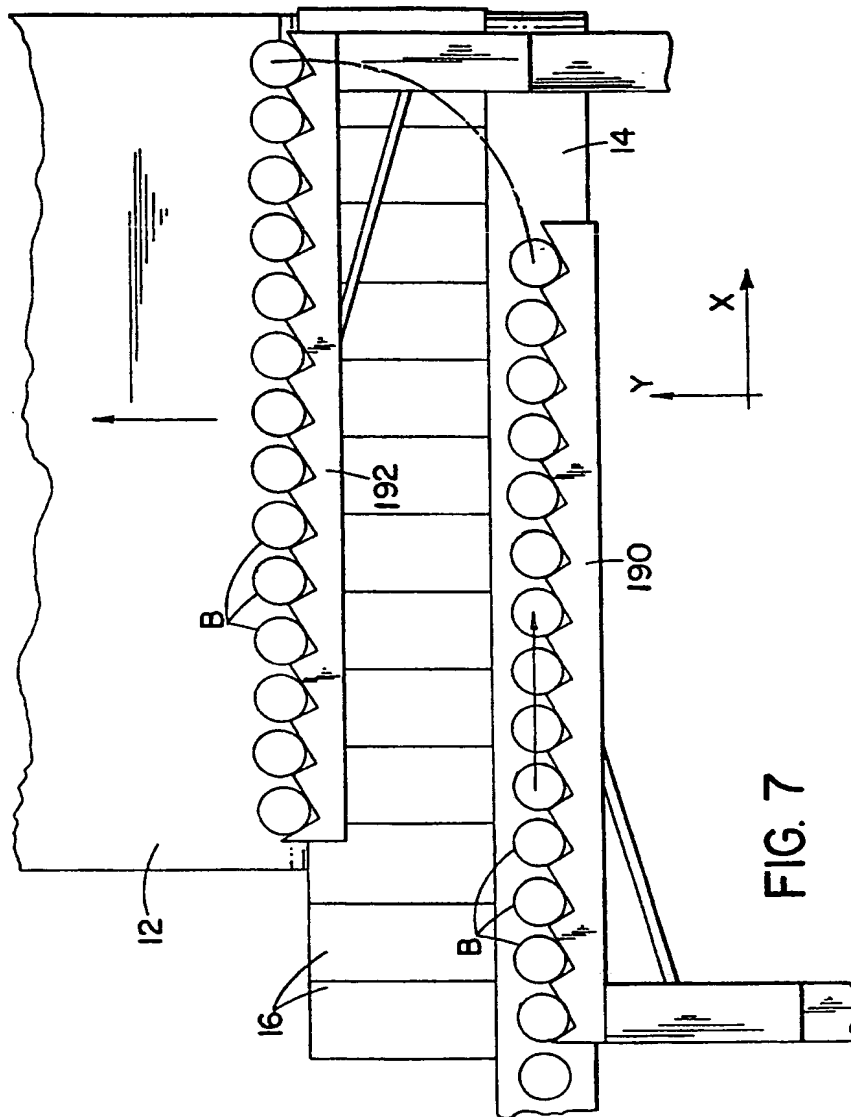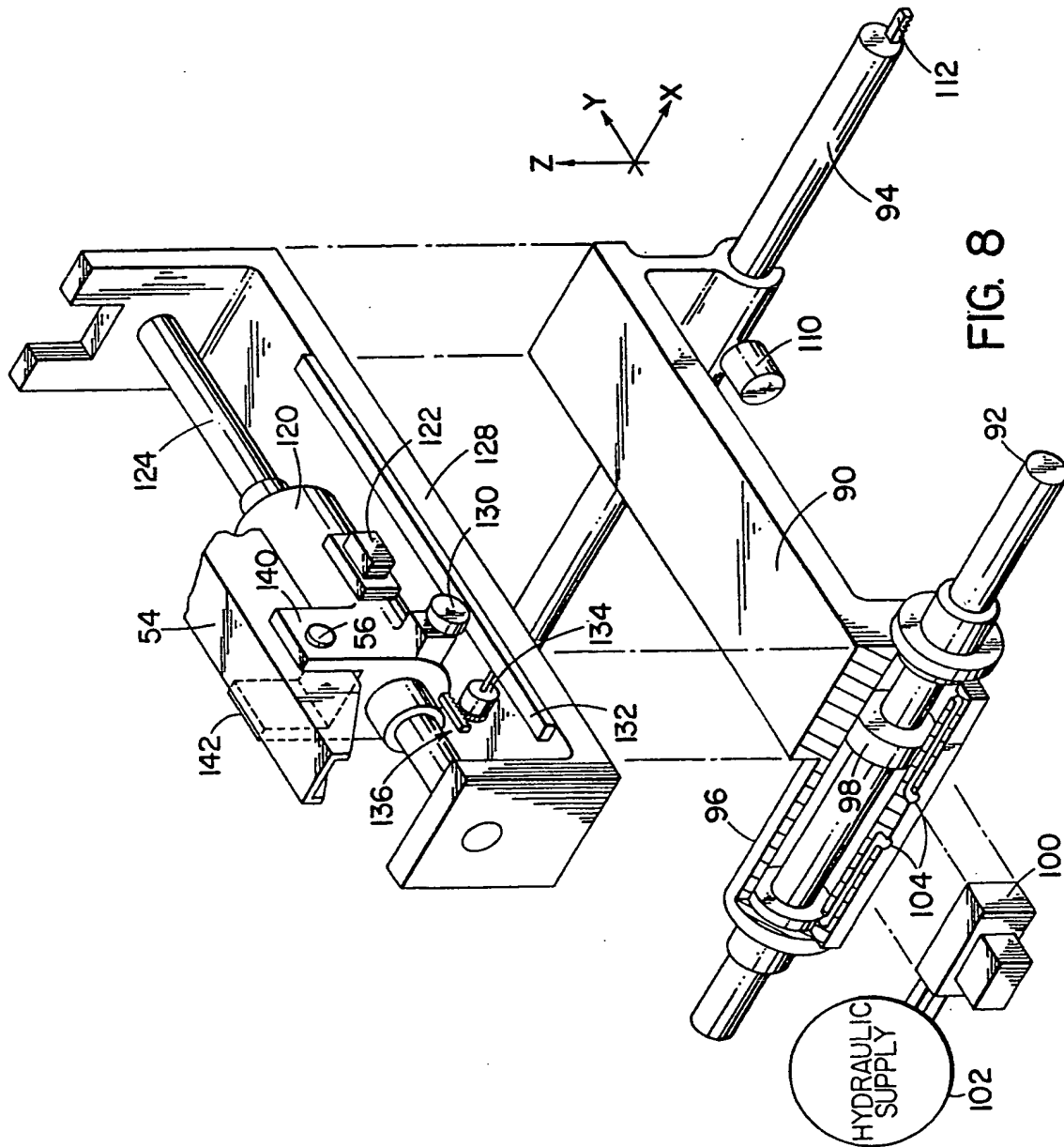2174667

FIG. 5

FIG. 6

FIG. 7

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FIG. 8

HYDRAULIC
SUPPLY

SPECIFICATION

Article-handling apparatus for transferring articles between conveyors

The present invention relates to an article-handling apparatus commonly referred to as a lehr loader or stacker which transfers articles from a series on one conveyor to groups in rows or ranks on another conveyor. The apparatus is typically used in conjunction with an I.S. glassware machine for forming an array of glass articles that pass through an annealing lehr.

Lehr loaders or stackers are well known in the art. Typical loaders are shown in U.S. Patents 3 184 031; 3 687 262; 3 994 387; 4 003 464; and 4 067 434. While some of the stackers employ simple linkage mechanisms to operate the pusher bars and move the glassware between conveyors, in general more accurate control over the displacement paths of the ware is desired. For this reason, the stackers include cams and linkages that move the pusher bar with composite motions in at least two coordinate directions and establish a predetermined displacement path for the ware. The displacement paths must have velocity and displacement profiles or curves which produce changes in speed or direction that can be tolerated by the more fragile, newly formed ware prior to annealing in the lehr.

Frequently, it is necessary to change the displacement paths when, for example, the style, shape, size or weight of the ware is changed or when the frequency, spacing, or speed of the ware from the forming machine is varied. Under such circumstances, the cam driven stackers must be shut down, disassembled and reassembled while new cams are installed. Furthermore, since one cam defines only one displacement path for an article of glassware, a plurality of cams must be available or be on hand at all times for any change in the glassware-making process. The storage of a large number of cams is inconvenient, and the potential for losing one or more of the cams always exists.

Because of the difficulties and delays associated with the changing of cams during different glassware operations, cam operated loaders are not suited to fully automated glassware systems which are monitored and controlled by a computer. Ideally, data in the form of a job number should be inserted into the computer controls for the machine, and all adjustments in timing, temperature, and displacement should occur without assembling or disassembling the machine. With a cam operated lehr stacker, this is not possible.

It is accordingly a general object of the present invention to provide a lehr loader or stacker that can be controlled by a computer or microprocessor and in which various glassware-handling displacement and timing parameters can be

changed instantaneously, unlike a cam operated machine.

The present invention resides in a cyclically operated article-handling apparatus for transferring a series of articles, such as glassware, advancing in a first coordinate direction on a cross conveyor onto a lehr conveyor running in a second orthogonal coordinate direction. The apparatus transfers the articles in groups to form rows or ranks of articles for movement in the second coordinate direction through an annealing lehr. The cross conveyor is located at the loading end of the lehr conveyor in perpendicular relationship with the lehr conveyor, and a dead plate is disposed between the two conveyors to support the glassware during the transfer operation.

The apparatus includes a first carriage that moves back and forth in the first coordinate direction parallel to the movement of the cross conveyor, and a second carriage movable back and forth in the second coordinate direction parallel to the movement of the lehr conveyor. In the preferred embodiment, one carriage, such as the second carriage, is mounted on the other and the pusher bar is connected with the mounted carriage for movement in the two coordinate directions.

First servo-actuating means is connected in driving relationship with the first carriage and produces movement of the first carriage and the pusher bar relative to the conveyors in the first coordinate direction. Second servo-actuating means is connected in driving relationship with the second carriage and produces movement of the second carriage and pusher bar relative to the conveyors in the second coordinate direction. Together the two carriages and associated servo-actuating means produce composite movements that enable the pusher bar to move the glassware between the conveyors along predetermined two-dimensional displacement paths.

In order to establish the desired path, a programmable control means is connected in operative relationship with the first and second servo-actuating means and controls the movement of the two carriages. The programmable control means includes a data memory for storing displacement programs for the two carriages and the pusher bar. The programs define the displacements of the first and second carriages in the first and second coordinate directions respectively, and are executed in each cycle of the apparatus which moves a series of articles onto the loading end of the lehr conveyor from the cross conveyor.

By providing two carriages and corresponding servo-actuating means for independent movement in the two coordinate directions, the displacement of the pusher bar is not restrained by mechanical components, such as the cams utilized in the prior art, and the displacement profiles in each coordinate direction can be controlled independently to produce

any desired composite motion and displace-
ment path between the cross conveyor and
the lehr conveyor. Furthermore, changes in the
displacement profiles can be made immedi-
5 ately through a control terminal, such as a
keyboard or other data entry device, that is
part of the programmable control means. A
plurality of pre-established displacement pro-
grams can be held in a random access mem-
10 ory of the control means and individual pro-
grams can be selected as desired through
coded entries or data keys, or new displace-
ment programs can be entered and stored.
    Preferred embodiments of the invention are
15 described in detail hereinafter with reference
to the accompanying drawings in which:
    Figure 1 is a perspective view showing one
embodiment of the novel article-handling appa-
ratus serving as a stacker at the input end of
20 a lehr conveyor.
    Figure 2 is a horizontal elevation view of the
stacker in Figure 1.
    Figure 3 is a top plan view of the stacker in
Figure 1 with the servo actuators shown sche-
25 matically.
    Figure 4 is a diagram illustrating typical dis-
placement and velocity profiles produced by a
displacement program in the programmable
controller.
30 Figure 5 is a schematic diagram of the pro-
grammable controller having a microprocessor
design.
    Figure 6 is a three dimensional diagram illus-
trating the pusher bar displacements in a com-
35 plete cycle of operation between the cross
conveyor and the lehr conveyor.
    Figure 7 is a plan view showing an alternate
embodiment of the apparatus.
    Figure 8 is a perspective view similar to
40 Figure 1 and shows the stacker carriages in
another embodiment of the novel article-hand-
ling apparatus.
    Figure 1 illustrates one embodiment of the
article-handling apparatus of the present inven-
45 tion in the form of a lehr loader or stacker,
generally designated 10. The stacker 10 is
located at the loading end of a lehr conveyor
12, and bottles B are fed into the stacker in
series on a cross conveyor 14 from an IS
50 forming machine. The bottles arrive in groups
corresponding to the pattern and order in
which the individual sections of the forming
machine operate, and the stacker 10 transfers
the bottles B in groups from the in-feed or
55 cross-conveyor 14 over dead plates 16 onto
the lehr conveyor 12 so that each transferred
group of bottles forms a row or rank on the
lehr conveyor. The bottles then pass en
masse through the lehr (not shown)   .   where
60 they are heated and annealed.
    A pusher bar 20 moves the bottles from
the cross conveyor 14 to the lehr conveyor
12 by sliding the bottles off the conveyor 14
across the dead plates 16 onto the loading
65 end of the lehr conveyor 12. The bar 20 op-

erates in a cyclic manner and displaces the
bottles along a path that results in a smooth
transition from the bottle movement in the X-
coordinate direction in the conveyor 14 to the
70 movement in th Y-coordinate direction on the
lehr conveyor 12. Speed and directional
changes occurring during this course of move-
ment are made as small as possible, taking
into consideration the rate at which the
75 bottles are formed, but are generally accom-
plished without any additional supporting de-
vices other than profiled teeth 22 on the
channel-shaped pusher bar 20.
    In one cycle of operation beginning with the
80 pusher bar 20 in the position adjacent the
cross conveyor 14 as illustrated in Figures
1,2, and 3, the bar is moved along a displace-
ment path P shown in Figures 3 and 4 by
composite movement of the pusher bar in the
85 X- and Y-coordinate directions. It will be un-
derstood that the displacement path P illus-
trates the movement of one of the bottles
between the two conveyors and that each of
the other bottles in the series follows a paral-
90 lel path on to the lehr conveyor.
    Preferably, as shown in Figure 4, the pusher
bar initially moves toward the bottles on the
cross conveyor at a relatively low velocity V_y
in the Y-coordinate direction and also parallel
95 with the bottles at a synchronous velocity V_x
in the X-coordinate direction. Once contact is
made with the bottles, the pusher bar acceler-
ates very rapidly in the X-coordinate direction
to a speed in excess of that of the cross
100 conveyor 14 to shift the bottles laterally on
the dead plates into alignment with the lehr
conveyor, and after the bottles are on the lehr
conveyor, the velocity Vx drops rapidly back
to zero. The velocity Vy of the pushing bar
105 toward the lehr conveyor increases at a more
gradual rate as the bottles move across the
dead plates 16 and reaches a peak near the
middle of the dead plates. The velocity Vy
drops off and finally reaches zero when the
110 bottles rest on the loading end of the lehr
conveyor 12.
    To control the displacement and velocities
of the pusher bar and bottles and to vary
these kinematic parameters independently in
115 each of the X- and Y-coordinate directions,
the pusher bar 20 is mounted on an X-car-
riage 30 for movement in the X-coordinate
direction and on a Y-carriage 32 for move-
ment in the Y-coordinate direction. The X-car-
120 riage 30 is slidably mounted on a pair of
guide bars 34, 36, and the carriage is moved
back and forth by means of a servo actuator
comprised by an electrical servomotor 38 with
a ball lead screw 40 driven by the motor. The
125 lead screw engages a recirculating ball nut 42
that is attached to the underside of the car-
riage 30.
    The Y-carriage 32 is mounted directly on
the X-carriage 30, but in Figure 1, the X-
130 carriage and associated supporting and driving

structure are shown in a downwardly pro-
jected position for purposes of clarity. The Y-
carriage 32 is slidably mounted on a pair of
guide rods 46, 48 which are fixedly mounted
5 to the X-carriage 30 and is moved back and
forth in the Y-coordinate direction by means
of a servo actuator comprised by an electrical
servomotor 50 with a ball lead screw 52
driven by the motor. The ball lead screw con-
10 nects to a recirculated ball nut (not shown)
that is fastened to the underside of the car-
riage 32.
    The pusher bar 20 is suspended from the
forward end of a support arm 54, and the
15 arm is pivotally connected to the rear end of
the Y-carriage 32 by a pin 56. Thus, the
pusher bar will move in the X- and Y-coordi-
nate directions with the X- and Y-carriages
32, 34 respectively and can be elevated and
20 lowered in the Z-coordinate direction relative
to the conveyors 12, 14 and bottles B by the
pivoting movement of the support are 54.
Such movement is necessary during the return
motion of the pusher bar from the lehr con-
25 veyor to the cross conveyor since the cross
conveyor 14 generally moves continuously and
brings the next series of bottles B to be
transferred into position behind the pusher bar
through the U-shaped bracket 58 at the pro-
30 jecting end of the support arm 54.
    The pusher bar 20 is elevated in the Z-
coordinate direction by means of a servo actu-
ator that is comprised by the drive motor 60
and the actuating link 62. As shown in Figure
35 2, the drive motor 60 has a linearly moved
output shaft 64 which is pivotally mounted to
the rear end of the support arm 54. Since the
velocity profile in the Z-coordinate direction is
not critical, the drive motor 60 may be a
40 pneumatic actuator having a fixed displace-
ment piston pivotally connected to the upper
end of the actuating link 62. The link 62 is
pivotally connected at axis 66 to the support
arm 54, and at the lower end is provided with
45 rollers or bearings 68 which contact and travel
on the Y-carriage 32 when the link 62 is ro-
tated about the pivot axis 66 by the pneuma-
tic actuator. As the link 62 rotates clockwise
from the position illustrated in Figure 2, the
50 support arm 54 and pusher bar 20 are ele-
vated to the phantom position such that the
bar clears any of the bottles B on the cross
conveyor 14 behind the bar. When the bar 20
returns to a position on the opposite side of
55 the cross conveyor from the lehr conveyor
12, the actuator 60 is de-energized and the
arm 54 is lowered onto the Y-carriage 32 in
the position illustrated with the pusher bar 20
in the solid line position.
60   Figure 5 illustrates the programmable con-
troller that is connected in operative relation-
ship with the servo actuators that produce
pusher bar movement along the coordinate
axes. The controller is a microprocessor-based
65 design in the preferred embodiment and in-

cludes a microprocessor 70 that produces the
control signals for each of the servo actuators
38, 50, and 60. The control channels for the
X- and Y-coordinate axes are closed loop and
70 hence a position feedback transducer 72 is
connected the the X-servo actuator 38 and
another position feedback transducer 74 is
connected with Y-servo actuator 50. The
feedback transducers provide position and
75 velocity information to cause the X- and Y-
carriages to precisely track the profiles defined
by displacement programs in the programma-
ble controller.
    A random access memory 80 forming part
80 of the microprocessor or supplementing the
processor memory stores predetermined dis-
placement programs or displacement programs
which are defined and loaded in the memory
by the control terminal 82 through the data
85 bus 84. Typically, the control terminal would
be a key-board, a tape reader or punch card
reader, a data key reader or possibly another
computer in which the velocity profiles are
generated, either interactively or automatically.
90 Alternatively, or in addition to the memory 80,
an additional read-only memory 86 can be
connected with the data bus 84 to store addi-
tional programs that are utilized on a recurring
basis. Hence the memory 86 must be nonvo-
95 latile and typically would be composed of EP-
ROM's.
    The machine operator or, in the event of a
fully automated system, another computer,
calls up a particular displacement program that
100 defines a desired path of movement for the
pusher bar 20 and the bottles B between the
cross conveyor 14 and the lehr conveyor 12.
That program is then loaded into a temporary
memory within the processor 70, and with
105 additional timing signals received from the
glassware machine, the microprocessor con-
trols the pusher bar 20 to load the lehr con-
veyor in a cyclic operation.
    If, after a particular run, a new bottle or a
110 different sequence of operations distributes
the bottles in a new manner on the cross
conveyor, another displacement program can
be readily called up through the control termi-
nal 82, and the glass-making process can
115 continue virtually uninterrupted and without
changing cams and restructuring the machine.
    Furthermore, the displacement programs can
be clipped or started at different locations
along the programmed displacement through
120 simple data manipulation. Accordingly, the in-
dependently controlled carriages which support
the pusher bar 20 permit an infinite variety of
displacement programs to be employed, and
changes in the programs can be made by the
125 machine operator through a simple data entry.
    While the present invention has been de-
scribed above in one preferred embodiment, it
should be understood that numerous modifica-
tions and substitutions can be had without de-
130 parting from the spirit of the invention. For

example, the servo actuators shown in Figures
1 and 2 are described as electrical servomo-
tors which generally include the feedback
transducers illustrated in Figure 5. However,
5 other types of servo actuators, including pneu-
matic and hydraulic motors, can be employed
for moving the X and Y carriages on which
the pusher bar 20 is supported.

In this regard, Figure 8 illustrates an em-
10 bodiment in which the X-carriage 90 is sli-
dably mounted on a pair of stationary support
rods 92,94 and is moved by means of a hy-
draulic actuator comprised of a cylinder 96, a
piston 98, and a hydraulic servovalve 100.
15 The valve controls the flow of hydraulic fluid
between a hydraulic supply 102 and the con-
trol ports 104 on the cylinder. The valve 100
is shown in an exploded position in order to
illustrate the ports, and would otherwise be
20 secured to the side of the cylinder in overlying
relationship with the ports.

The piston 98 is secured or otherwise at-
tached fixedly to the support rod 92 so that
hydraulic fluid pressure developed in either
25 end of the cylinder causes the cylinder and
the X-carriage 90 to move together along the
rods 92,94 in the illustrated X direction.

A rotary position feedback transducer 110
mounted on the X-carriage 90 engages a gear
30 rack 112 secured to the bottom side if the
guide rod 94, and as the carriage moves back
and forth, the transducer produces a feedback
signal for accurate control of carriage position.

The Y-carriage 120 is comprised primarily
35 by the cylinder of another hydraulic actuator
having a servovalve 122 and a piston (not
shown) mounted fixedly on a piston rod 124
within the cylinder. Like the valve 100, the
valve 122 is connected to the hydraulic supply
40 102 and controls the flow of hydraulic fluid
into the cylinder to cause the cylinder and
attached structure to move back and forth on
the piston rod 124 in the Y-coordinate direc-
tion.
45 The Y-carriage 120 and associated structure
is mounted on the X-carriage 90 by means of
a connecting frame member 128. The frame
member is fixedly attached to the top of the
X-carriage 90 as indicated, and the piston rod
50 124 is fixedly attached to the frame member.

To stabilize the Y-carriage or cylinder 120
within the frame member 128, a pair of rollers
130 (only one visible) are secured on opposite
sides of the cylinder. The rollers rest on top
55 of a corresponding pair of guide ways 132
(only one visible) which are also secured to
the frame member 128. The guide ways 132
additionally serve as ways for the lifting link
62 in Figures 1 and 2 for lifting the pusher
60 bar up and down in the Z-coordinate direction.

A rotary position feedback transducer 134
is secured to the frame member 128 below
the Y-carriage 120, and is engaged by a gear
rack 136 fixed to the lower side of the car-
65 riage. Thus, movement of the carriage in the

Y-coordinate direction produces a feedback
signal in essentially the same fashion as the
feedback transducer 110 secured to the X-
carriage.
70 The carriage 120 has two lugs 140,142 at
its rear, upper side. The support arm 54 from
which the pusher bar (not shown) is mounted
in cantilever fashion is pivotally mounted be-
tween the lugs on the pin 56 in the same
75 manner as in Figures 1 and 2. The servo actu-
ator 60 that pivots the support arm 54 on the
pin 56 and simultaneously moves the pusher
bar up and down in the Z-coordinate direction
is not shown for clarity, but mounts above
80 the support arm and operates the support arm
in conjunction with the link 62 as described
previously. If desired, the servo actuator 60
may be a hydraulic actuator connected with
the hydraulic supply 102 through a four-way
85 solenoid valve. The solenoid valve and the
two servovalves 100 and 122 can be con-
trolled by the microprocessor 70 to move the
pusher bar 20 in the same manner as de-
scribed above in connection with Figure 5.
90 Although the invention has been described
above in the context of a single pusher bar
and associated carriages, it is also applicable
to compound systems such as shown in Fig-
ure 7 wherein two separate pusher bars per-
95 form the transferring operations alternately
with a reduced duty cycle on each bar. In
other words, the pusher bar 190 moves half
of the incoming bottles B between the cross
feed conveyor 14 and the lehr conveyor 12
100 every other cycle of operation while the
pusher bar 192 transfers the other half of the
bottles between the conveyors during the in-
tervening cycles. In such case, each pusher
bar is supported independently by its own X-
105 and Y-carriages and each set of carriages is
controlled separately by the microprocessor.

The pusher bars 190,192 utilize the same
displacement profile or path P between con-
veyor 14 and conveyor 12, as shown in Fig-
110 ure 6, but operate in an 180°-phase relation-
ship so that each bar transfers bottles at dif-
ferent points in time. The return paths for the
bars, however, are preferably different to
avoid interference. For example, the bar 190
115 utilizes a return path Pl in Figure 6, such that
which would be used by the bar 20 in Figures
1-3, while the bar 192 utilizes the dotted re-
turn path P2.

Accordingly, the present invention has been
120 described in several preferred embodiments by
way of illustration rather than limitation.

CLAIMS
1. A cyclically operated article-handling
125 apparatus for transferring a series of articles
advancing in a first coordinate direction (X) on
a first conveyor onto a second conveyor in
groups to form rows or ranks of articles for
movement in a second orthogonal coordinate
130 direction (Y), the first conveyor being located

in perpendicular relationship with the second conveyor at the loading end of the second conveyor and a dead plate being disposed in between the two conveyors, comprising

5 a first carriage movable back and forth in the first coordinate direction parallel to the movement of the first conveyor;

a second carriage movable back and forth in the second coordinate direction parallel to the 10 movement of the second conveyor;

an article-engaging pusher bar supported by the first and second carriages above the first conveyor, the dead plate, and the second conveyor for engagement with the articles and 15 movement of the articles between the two conveyors in the first and second coordinate directions;

first servoactuating means connected in driving relationship with the first carriage and pro-20 ducing movement of the first carriage and the pusher bar relative to the conveyors in the first coordinate direction;

second servoactuating means connected in driving relationship with the second carriage 25 and producing movement of the second carriage and pusher bar relative to the conveyors in the second coordinate direction; and

programmable control means connected in operative relationship with the first and sec-30 ond servoactuating means for controlling movement of the first and second carriages and including a data memory for storing displacement programs defining predetermined movement of the first and second carriages 35 and the pusher bar in the first and second coordinate directions.

2. An article-handling apparatus for transferring articles on a first conveyor onto a second conveyor as defined in claim 1 further 40 comprising:

a third carriage supporting the pusher bar for movement up and down in a third coordinate direction relative to the conveyors and the articles; and

45 third servoactuating means being connected in driving relationship with the third carriage and in operative relationship with the programmable control means for independently controlling movement of the third carriage, 50 the data memory storing displacement programs also defining predetermined movement of the third carriage and pusher bar in the third coordinate direction.

3. An article-handling apparatus for trans-55 ferring a series of articles on a first conveyor onto a second conveyor as defined in claim 1 wherein the data memory of the programmable control means includes a plurality of predetermined displacement programs, and the 60 programmable control means additionally includes means for selecting specific displacement programs from the data memory for controlling the movement of the first and second carriages by the first and second servoac-65 tuating means.

4. An article-handling apparatus for transferring a series of articles on a first conveyor onto a second conveyor as defined in claim 2 wherein the data memory of the programma-70 ble control means includes a plurality of predetermined displacement programs, and the programmable control means additionally includes means for selecting specific displacement programs from the data memory for 75 controlling the movement of the first, second and third carriages by the first, second, and third servoactuating means.

5. An article handling apparatus for transferring a series of articles on a first conveyor 80 onto a second conveyor as defined in claim 1 wherein

each displacement program in the data memory contains data defining coordinated displacements of the first and second car-85 riages between the first conveyor and the second conveyor.

6. An article handling apparatus for transferring a series of articles on a first conveyor . onto a second conveyor as defined in claim 4 90 wherein

each displacement program in the data memory contains data defining coordinated displacements of the first, second, and third carriages back and forth between the first 95 conveyor and the second conveyor.

7. An article-handling apparatus for transferring a series of articles on a first conveyor onto a second conveyor as defined in claim 1 wherein

100 one of the first and second carriages is mounted on and movable relative to the other of the carriages, and the servoactuating means associated with said one of the first and second carriages is also mounted on the other of 105 the carriages; and

the pusher bar is mounted on said one of the first and second carriages for movement with the carriages in each coordinate direction respectively.

110 8. An article-handling apparatus for transferring a series of articles on a first conveyor to a second conveyor as defined in claims 1 wherein

the memory of the programmable control 115 means contains a plurality of displacement programs defining composite movements of the first and second carriages in the first and second coordinate directions; and

the programmable control means further in-120 cludes means for selecting a predetermined one of the plurality of displacement programs for controlling movement of the first and second carriages and the pusher bar by the servoactuating means.

125 9. A lehr loader for cyclically transferring groups of articles moving in a series on a cross conveyor onto a lehr conveyor arranged transversely of the cross conveyor, the groups of the articles transferred being arranged on 130 the lehr conveyor in rows or ranks generally

parallel to the series of articles on the cross
conveyor for movement through a lehr, com-
prising:
   a first carriage movable back and forth in a
5 first coordinate direction parallel to the move-
ment of the articles on the cross conveyor;
   first servo actuator means connected in con-
trolling relationship with the first carriage for
controlling carriage movement in the first co-
10 ordinate direction;
   a second carriage movable back and forth in
a second coordinate direction parallel to the
movement of the rows of articles on the lehr
conveyor;
15   second servo actuator means connected in
controlling relationship with the second car-
riage for controlling carriage movement in the
second coordinate direction;
   a pusher bar supported from the first and
20 second carriages over the cross conveyor and
the lehr conveyor for movement back and
forth between the conveyors in the first and
second coordinate directions, the bar being in
a position generally parallel to the series of
25 articles on the cross conveyor and the rows
of articles on the lehr conveyor and engaging
the articles in pushing relationship during bar
movement from the cross conveyor to the
lehr conveyor,
30   programmable control means connected
with the first and second servo actuator
means for controlling the movement of the
pusher bar between the conveyors by the
servo actuator means, the control means in-
35 cluding a control terminal for entering data
and a data memory for storing displacement
programs defining coordinated movements of
the pusher bar and engaged articles in the
two coordinate directions along a predeter-
40 mined path between the conveyors whereby
the programmable controller can be pro-
grammed through the control terminal to move
the articles between the conveyors along a
preselected path defined by a stored displace-
45 ment program.
   10. A lehr loader for cyclically transferring
groups of articles as defined in claim 9
wherein:
   the data memory has a memory capacity for
50 storing a plurality of displacement programs
defining a plurality of predetermined paths of
movement between the conveyors; and
   the control terminal connects with the data
memory to select the displacement programs
55 individually for controlling the pusher bar and
article movement between the conveyors.
   11. A lehr loader for cyclically transferring
groups of articles as defined in claim 9
wherein the first and second servo actuator
60 means comprise electrical servo motors.
   12. A lehr loader for cyclically transferring
groups of articles as defined in claim 9
wherein the first and second servo actuator
means comprise hydraulic actuators.
65   13. A cyclically operated article-handling

apparatus substantially as hereinbefore de-
scribed with reference to and as shown in
Figures 1,2,3 and 5 of the accompanying
drawings.
70   14. A cyclically operated article-handling
apparatus substantially as hereinbefore de-
scribed with reference to and as shown in
Figure 7 of the accompanying drawings.
   15. A cyclically operated article-handling
75 apparatus substantially as hereinbefore de-
scribed with reference to and as shown in
Figure 8 of the accompanying drawings.